Research evaluation

EVALUATION REPORT OF THE UNIT

MoSAR - Modélisation Systémique Appliquée aux Ruminants

UNDER THE SUPERVISION OF THE FOLLOWING ESTABLISHMENTS AND ORGANISMS:

AgroParisTech / Université Paris Saclay

Institut national de recherche pour l'agriculture, l'alimentation et l'environnement - INRAE

EVALUATION CAMPAIGN 2024-2025

GROUP E

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High Council for evaluation of research and hgher education

In the name of the expert committee:

Walter Gerrits, chairman of the committee

For the Hcéres:

Stéphane Le Bouler, acting president

In accordance with articles R. 114-15 and R. 114-10 of the Research Code, the evaluation reports drawn up by the expert committees are signed by the chairmen of these committees and countersigned by the president of Hcéres.

To make the document easier to read, the names used in this report to designate functions, professions or responsibilities (expert, researcher, teacher-researcher, professor, lecturer, engineer, technician, director, doctoral student, etc.) are used in a generic sense and have a neutral value.

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

MEMBERS OF THE EXPERT COMMITTEE

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REPRESENTATIVES OF SUPERVISING INSTITUTIONS AND BODIES

Mr Xavier Fernandez, INRAE
Mr Alexandre Péry, AgroParisTech/Université Paris-Saclay

CHARACTERISATION OF THE UNIT

- Name: Modélisation Systémique Appliquée aux Ruminants
- Acronym: MoSAR
- Label and number: UMR 0791
- Composition of the executive team: Head of the unit (DU): Ms Laurence Puillet, Deputies (DUA): Ms Christelle Loncke, Mr Rafael Munoz-Tamayo and Ms Masoomeh Taghipoor

SCIENTIFIC PANELS OF THE UNIT

SVE: Life, Health and Environmental Sciences

SVE2: Plant and Animal Production (Agronomy), Plant and Animal Biology, Biotechnology and Biosystems Engineering

THEMES OF THE UNIT

The research activities aimed at understanding the relations between the ruminants and their nutritional environment and three concerned interfaces: Feed × Animal, Microbiota × Animal and Organs × Animal. Research focused on ingestion and feeding behavior, ruminal function and microbial metabolism, nutrient allocation as determinants of feed efficiency and resilience. Research combined modelling and experimental approaches.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

MoSAR is a joint research unit (UMR) between INRAE and AGROPARISTECH, physically situated in Campus Agro Paris-Saclay (CAPS), Palaiseau, with an experimental facility on dairy goats at Grignon. In 2022, the unit moved from the historical location in Paris to the new Campus Agro Paris-Saclay (CAPS) in Palaiseau. Thus, the unit, previously attached to the INRAE center of Ile-de-France Jouy-en-Josas, has been attached to the centre of Ile-de-France Versailles-Saclay. MoSAR came into being on the 1st of January 2010, prior to this the unit was called "Physiologie de la Nutrition et Alimentation." The unit has a long-standing expertise in ruminant nutritional physiology and feed evaluation, mainly applied to dairy goats, as well as in systemic modelling of animal physiology and biology. Since becoming MoSAR, the scientific objectives of the research unit have evolved to give to the systemic modelling aspect a more central role in the team project, together with a focus on the characterisation of phenotypic variation in the acquisition and allocation of nutrients to different biological functions. On the 1st of June 2018, Maryline Boval became director and Philippe Schmidely deputy director (until 2019). Laurence Puillet became director on the 1st of January 2023, with a team of three deputies (Christelle Loncke, Rafael Munoz-Tamayo, Masoomeh Taghipoor).

RESEARCH ENVIRONMENT OF THE UNIT

The MoSAR unit is under the supervision of two governing bodies: i) The PHASE (Animal Physiology and Livestock Farming Systems) division of INRAE, and ii) AGROPARISTECH, a public university-level college for life and environmental sciences. The scientific objectives of MoSAR are aligned with several research axes of these supervising bodies and the unit contributes to the training of agronomy engineers, Master and PhD fellows.

Regarding its local ecosystem, MoSAR is integrated into the University of Paris-Saclay. The unit co-coordinates an axis on animal sciences and is also responsible for Open Science of the graduate school BioSphera dedicated to life sciences, and participates to the steering committee of the graduate school MRES (Métiers de la Recherche et de l'Enseignement Supérieur) around higher education and careers in research. MoSAR is also a member of the Paris-Saclay scientific pole Animal sciences Paris Saclay with six other local research laboratories.

In terms of partnership, MoSAR collaborates and transfers knowledge to the livestock sector (technical institutes, feed industry, farmers' organisations) through its expertise on ruminant nutrition, especially in the goat, modelling and phenotyping of animal efficiency and resilience. The unit is a partner of the mixed technological unit (UMT) Systèmes Caprins Durables de Demain (SC3D) and the Goat Feeding and Nutrition group of IDELE, the French Livestock Institute.

UNIT WORKFORCE: in physical persons at 31/12/2023

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maîtres de conférences et assimilés	4
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	11
Sous-total personnels permanents en activité	**21**
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	1
Post-doctorants	0
Doctorants	9
Sous-total personnels non permanents en activité	**11**
Total personnels	**34**

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: in physical persons at 31/12/2023. Non-tutorship employers are grouped under the heading "others".

Nom de l'employeur	EC	C	PAR
INRAE	0	4	10
AgroParisTech	6	0	1
Total personnels	**6**	**4**	**11**

GLOBAL ASSESSMENT

Objectives

The objectives formulated by MoSAR over the evaluation period are clearly formulated and are connected to the work done in an excellent manner. The connection between these objectives and the overarching objectives AgroParisTech and INRAE can be considered very good. The directors of these parent institutes confirmed that the focus on understanding and modelling feed efficiency and resilience/robustness of ruminants is also considered at the heart of their sustainability and scientific objectives.

Resources

The unit has faced important losses of permanent staff during the evaluation period, at the level of technicians and researchers, largely for reasons of geographic mobility and retirement. This is a reason for concern for the work done at the goat farm, the lab, and continuity of scientific output. Coping with this has been quite challenging over the evaluation period. At the moment, new staff are being recruited, and the committee received signals of improved working atmosphere under the new leadership.

Scientific and technical skills are very good, particularly for the modelling approaches. There is a note of concern for the continuity of the work at the laboratories and the in vitro work, which are also at the heart of the work of MoSAR. The committee sees the increase in the number of PhD students and postdocs over the evaluation period as a development that is very good and is a strategy that is important to continue.

The ability of the unit to find financial resources is very good through important research contracts at the European level and the ability to fund PhD students.

The goat farm is an excellent facility that serves to integrate experimental research/phenotyping with the modelling work, the idea of which is strongly supported by the parent institutes. Integrating this facility in the budget of the unit causes high commitment of its use and further development by researchers. In general, the choice of animal facilities to use (own facilities or through collaboration) to reach the objectives of the unit deserves careful and continuous consideration.

Organisation and functioning of the unit.

The organisation and functioning of the unit in terms of human resources management, social and environmental responsibility, data management and open science is very good. The large number of staff involved in the management of the unit has been serving the purpose of the difficult transition period (moving location, loss of staff) very well. For the future, the unit should reconsider this as it potentially prevents choices from being made and causes unnecessary heavy overheads.

Attractiveness

The attractiveness is considered very good, judged by (inter)national reputation and appeal in animal modeling and phenotyping regarding on the numerous participations in projects and recruitment on PhD and postdoc fellows. The open science strategy of the unit is excellent.

Scientific Production

The quality of the scientific production can be considered very good, judged by the international reputation of selected journals, a large share of published meta-analyses, and the scientific leadership. There are concerns about the potential to sustain this level of performance in the near future, considering the recent loss of scientific staff with a great reputation.

Contributions to Society

The contributions to society are very much focused on the very good to excellent connections with animal production, which are users of the knowledge generated. In addition, MoSAR integrates new knowledge in a very good way into their teaching activities. The parent institutes are highly supportive of this approach.

DETAILED EVALUATION OF THE UNIT

A - CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Previous recommendations have been implemented with regard to the stimulation and support of the most recently recruited scientists in scientific production (from 1.3 to 2.3 papers/scientists between 2018 and 2023), to the anchoring partnership with industrials (13 contracts), to the heterogeneous contribution of scientists to PhD supervision (with 3 HDR obtained by members of the unit) leading to an important increase of PhD fellows (12 vs. 7 in the previous period). The incitation to explore potential effort for patenting did not result in patent application but the unit registered with secret know-how a new in vitro device to study rumen fermentation. We note the asserted strategy for an Open Science strategy to enhance the share data and results.

We noted the integration into the Paris-Saclay University ecosystem (especially by contribution to two graduate schools, workshop organisation and collective animation) but also difficulties still remaining regards on material and practical aspects that are not in the control of MoSAR but are mentioned in your report.

The modelling at animal level was consolidated and permit to move to the herd level considering inter-individual variability and individual-based approaches. The animal level was further emphasized in the project considering the animal as a system and the animal in a system. The unit was able to realize its ambitious scientific project despite its size thanks to the active recruitment of postdoc and PhD fellows.

B - EVALUATION AREAS

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the scientific objectives of the unit

The unit has objectives that connect in an excellent way to the activities of the unit reported. Outlining the objectives along the three interfaces (feed x animal; microbiota x animal; organs x animal) provides excellent insight into the work done by the different teams. Reorganizing these into two axes for the coming contract period makes sense regarding the reduction in staff. The way the formulated objectives connect with the envisioned transition of livestock farming as formulated in the scientific priorities in the INRAE foresight (2020–2030) report and the AgroParisTech research plan (see page 24 of the self-assessment) can be considered good. The way the unit contributes to these overarching objectives (e.g. develop farming systems that create values and met societal expectations, closing nutrient cycles; propose sustainable farm management strategies) has not been addressed, but appears to be out of scope for the unit.

Assessment on the unit's resources

Despite losses in human resources, MoSAR unit maintained very good scientific and technical skills. The goat farm is an excellent facility that serves to integrate experimental research/phenotyping with the modelling work, The MoSAR unit has a very good ability to find financial resources PhD students through funding opportunities and research contracts.

Assessment on the functioning of the unit

The functioning of the unit in terms of human resources management, social and environmental responsibility, data management and open science is very good thanks to the implementation of clear internal operating rules and the use of dedicated tools. The unit efficiently ensures the management of an experimental farm, which has proved to be robust as evidenced during the COVID-19 period when experiments related to a European project were successfully carried out. This functioning is particularly remarkable as the unit is relatively small and faces to heavy losses of permanent staff but could become a weakness as the collective tasks are distributed on a limited number of people, which could negatively impact the scientific activities.

1/ The unit has set itself relevant scientific objectives.

Strengths and possibilities linked to the context

The scientific objectives of MoSAR stimulate scientific progress in its field of research. In particular, behavioral phenotyping to increase understanding of (variability of) feed intake/efficiency, connecting the rumen microbiome to dynamic functioning of the rumen, the role of management of body reserves in resilience and lifetime production are objectives that connect to the key expertise in MoSAR, are scientifically innovative and have an important role in the resolution of societal challenges. The way MoSAR's scientific objectives are positioned both nationally as internationally can be considered very good. They connect well with societally relevant problems that need to be addressed (emissions, resource efficiency) and are in the core of topics listed in EU-Horizon programs. The objective to work on alternatives for animal experimentation is strong and important, also for attracting funding in the future; In this area, focus is on in vitro systems replacing rumen-fistulated animals. With the expertise available, more options to reduce animal experimentation can be explored. As indicated above, the objectives are formulated along the lines of the work reported in the self-evaluation.

Weaknesses and risks linked to the context

Two weaknesses can be identified:

1) the connection with the overarching objectives of the supervisory authorities (INRAE and AgroParisTech) could be improved, even though these authorities are in full support of the objectives proposed by MoSAR. Taking the ruminant animal at the center of virtually all of its activities, MoSAR may lack progress in e.g. i) develop farming systems that create values and met societal expectations, ii) closing nutrient cycles; iii) propose sustainable farm management strategies. With its expertise, MoSAR could play a role that stretches further than the objectives currently formulated;

2) the terms robustness/resilience and health are mentioned, but the health expertise needed for this is underrepresented in MoSAR. The work on behaviour is restricted to feeding behaviour; if the opportunity on welfare is taken (SWOT analysis, p 24), this expertise needs to be extended.

2/ The unit has resources that are suited to its activity profile and research environment and mobilises them.

Strengths and possibilities linked to the context

Despite the reduction of permanent staff, MoSAR unit maintained high skills in animal science and particularly in modelling approaches, although resources in modelling are not precisely described. MoSAR has also in vitro fermentation systems. Twelve PhD fellows were hired, in progression compared to the previous evaluation period. The annual financial resources, excluding permanent salary costs varied between 369 k€ and 531 k€, with an increase from 68% to 79% of the proportion coming from contracts. MoSAR has an experimental facility at Grignon, which comprises a herd of 120 lactating goats, well equipped for phenotyping of feed efficiency, methane emissions and behaviour. Staff losses during the evaluation period created difficulties to run the experimental facility and the lab. The unit's budget partly went for short-term contracts towards addressing the human resource situation at the MoSAR experimental facility. This will become a weakness if the situation is not rapidly corrected.

Weaknesses and risks linked to the context

During the evaluation period, due to the move to the Campus Agro Paris-Saclay and retirement, the MoSAR unit lost 11 permanent staff: 1 PR, 2 MC, 2 CR, 1 DR, 1 IR, 1 IE, 3 TR. This led MoSAR to reorganise the unit around two axes: (i) Animal as a System and (ii) Animal in a System. The weaknesses and risks are well identified in the SWOT analysis performed by the MoSAR unit, the main ones being: 1) small size of the unit and loss of staff, 2) loss of expertise in ruminant nutrition and behaviour. This needs to develop a strong and targeted strategy to overcome these weaknesses. Due to the small size and the loss of expertise, it seems no longer possible to maintain the diversity of approaches, in particular as the unit identifies some overlapping of activities with bigger Inrae research units.

3/ The unit's practices comply with the rules and directives laid down by its supervisory bodies in terms of human resources management, safety, environment, ethical protocols and protection of data and scientific heritage.

Strengths and possibilities linked to the context

The unit direction is strongly engaged in the management of human resources. This is reflected by the implementation of actions and incentive measures against discrimination, allowing for balanced gender split (58% of women among scientists, slightly more men than women among technical staff), the organization of regular team-building sessions training on group cohesion, and the support for difficult situations with external assistance (e.g. INRAE expert manager for guidance on management). The unit follows INRAE's rules and trained staff regarding its social and environmental responsibility, especially by planning to use a dedicated tool (Labo1point5, developed by a group of French researchers).

The unit has established clear operating rules (use of an internal regulation document, data tool security), and a continuity plan within its experimental farm and labs, which has proved to be efficient and robust, particularly during the COVID-19 period when planned experiments were successfully carried out.

Finally, the unit is particularly committed to the application of open science principles, as demonstrated by its leadership role in this field evidenced by the regular invitations of several members of the unit in seminars on scientific integrity within the University of Paris-Saclay and INRAE.

Weaknesses and risks linked to the context

The small size of the unit is undoubtedly a weakness for some aspect of its functioning, as tasks of collective interest such as administrative management, quality assurance, risk prevention, social and environmental responsibility, and the important role of the team on animal welfare and well-being (SBEA) in the experimental farm are distributed among a limited number of people. This weakness is reinforced by the strong recent losses (6 mobilities and 5 retirements) concomitant to the move to the Paris-Saclay site, which also needs adaptations to new working conditions.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

The attractiveness of the unit is considered as very good regarding on the international, and national reputation and appeal in animal modeling and phenotyping, regarding on the numerous participation in projects, and the recruitment of PhD and postdoctoral fellows. The open science strategy of the unit is excellent.

1/ The unit has an attractive scientific reputation and is part of the European research area.

2/ The unit is attractive because for the quality of its staff support policy.

3/ The unit is attractive through its success in competitive calls for projects.

4/ The unit is attractive for the quality of its major equipment and technical skills.

Strengths and possibilities linked to the context for the four references above

The international collaborations are a strength of the unit. These were evidenced by the coordinating role of members of the unit in two European projects (H2020 GenTORE and PRIMA Adapt-Herd), the participation to four other European projects (H2020 Feed-a-gene, H2020 SMARTER, H2020 MASTER, PRIMA PAS-AGRO-PAS) and by the construction of two programs facilitating international collaborations (LIA with the University of Quebec and agreement with the University of Antioquia, Colombia). International reputation and appeal is also evidenced by eleven invitations as speaker in international congress (ADSSA, EAAP congress), involvement in

international organisational committees (ModNut congress, ADSA Conference), welcoming of four researchers (for periods varying from 2 to 8 months) from aboard.

At national level, the unit has a large presence in the French research area as some members of the unit are partners in various types of research projects (4 ANR, 3 Casdar, 1 PEPR, 1 PSDR, 1 Carnot, 2 APIIS-GENE, 9 INRAE Metaprogram, 2 Crédits incitatifs). This involvement is based on the skills of the unit in modelling and phenotyping, and technical associated equipment in the goat experimental facility. The unit also participates in national expert's comity of ANSES, to evaluating committees for lecturer and professor of the Ministry of Agriculture (CNECA), to managing board of the Association Française de Zootechnie (AFZ), and to the scientific councils of the INRAE department Physiologie Animale et Systèmes d'Elevages (PHASE) et Génétique (GA) and Ecole Nationale Vétérinaire de Toulouse (ENVT). The eleven projects for research collaboration or PhD funding (4 Cifre) with economic partners reflect a good recognition of the unit by the business community.

The unit has a strong open science strategy that is a key element for attractiveness, with one member of the unit being at the initiative and four researchers having editorial responsibilities in PCI Animal sciences, and with the deposition of databases and scripts for data processing in dedicated platforms.

The unit has an important implication in doctoral training with seventeen PhD fellows welcomed (vs. 12 during the previous period), participation in steering bodies of doctoral or graduate schools (ABIES, Métiers de la Recherche et de l'Enseignement Supérieur, and BIOSPHERA) (4 researchers implied and 1 director), involvement in 3 summer schools (Agreenium school, Paris, 2019; ABIES training, on-line, 2021; H2020 SMARTER summer school, Toulouse, 2023). During the reporting period, three members of the unit obtained an HDR leading to six HDR among thirteen scientists which increases the capability of the unit to supervise PhD projects. Doctorate funded were diversified (Cifre, French government, European Commission, International institutions). The number of articles co-signed with PhD candidates averaged 2.5 per thesis varying from 1 to 5.

Weaknesses and risks linked to the context for the four references above

The unit has suffered a major loss of staff during the period (geographical mobility or retirement) during the period, in particular regarding the technical staff working on facilities and laboratory. The situation is considered as optimal with five staff working in goat experimental facilities but it seems not to be the case for the laboratory with only one technician remaining. This situation has weakened the experimental dimensions of the research.
The recognition of the skills of the unit leads to numerous solicitations for research collaboration. In association with the small size of the unit, this could be a risk of dispersion.
The participation to national or international collaboration including project coordination is heterogeneous between the scientists and relies on some who are no longer with the unit. This could be a risk for the future.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

Quality of the scientific production appears very good, judged by the international reputation of selected journals, a large share of published meta-analyses, and the scientific leadership. The choice of journals is consistent with the aim of high-quality scientific output in the topic area and are highly reputable within the field. The large share (31%) of published reviews and meta-analyses is impressive (and could be better positioned in the 3R strategy). The substantial (51 chapters for both English and French versions) contribution to the INRAE feeding tables (2018) is important. Open science policies and practice appears excellent, with over 90% of journal articles in gold-open access, and an active preprint publication strategy (23 in the reporting period) and strive for making data and models accessible via public databases/repositories.

1/ The scientific production of the unit meets quality criteria.

2/ The unit's scientific production is proportionate to its research potential and properly shared out between its personnel.

3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science. It complies with the directives applicable in this field.

Strengths and possibilities linked to the context for the three references above

The scientific production of MoSAR meets quality criteria. It is evidenced by the large portion (> 1/3) of publications in journals that have a rigorous peer-review procedure in the topic area (e.g. ANIMAL, Journal of Dairy Science). Also, over 1/3 of the publications are either reviews or meta-analysis, evidencing the reputation of the scientists, and mastering the information available in literature. It is naturally connected with the vast efforts in modelling of the MoSAR unit. There is an increase in the number of PhD students (4 PhD students defended their thesis) and the capacity to supervise them (3 new HDRs). Nearly 60% of the publications have MoSAR scientists in lead positions.

Publications on ingestion, feeding behaviour and interactions with acidosis (goats) are strong. Articles on ruminal function and microbial metabolism are a good start for making better use of -omics data in this area, and open up possibilities for improving predictions of nutritional value and H2 and CH4 emissions. In the area of dietary recommendations, the substantial involvement in feed evaluation systems (INRAE tables 2018) is a strong point of MoSAR.

Open science policies and practice appears excellent, with over 90% of journal articles in gold-open access, and an active preprint publication strategy (23 in the reporting period) and strive for making data and models accessible via public databases/repositories. Predatory journals are almost completely avoided.

Weaknesses and risks linked to the context for the three references above

Even though the quality of the science is much more important than the volume of the scientific output, the latter seems a bit on the low side (on average ~1.7 journal articles/research FTE) with substantial variation between researchers. The dependence on some of the lead researchers is quite high and as some of them have left the unit, this will impact the scientific production on the short term. When scientific output is on the low side for too long, it damages the scientific impact of the high quality work conducted at the unit. Even though there is an increase in the number of PhD students (12 recruited in the last period) there is room for growth here.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

The interactions of the unit with the non-academic world are very good. In particular, the furtherance of its historical involvement in continuing improvement and dissemination of the INRAE feeding systems for the ruminants is an important achievement. The unit also contributes to the development of the goat sector through structuring actions, encourages theses with the private sector and develops innovation, allowing them to maintain a leadership in the domain of ruminant nutrition. Conversely, the relatively small number of actions towards the general public appears to be a weakness with a possible negative impact on its visibility at the local level.

1/ The unit stands out for the quality and the amount of its interactions with the non-academic world.

2/ The unit develops products for the cultural, economic and social world.

3/ The unit shares its knowledge with the general public and takes part in debates in society.

Strengths and possibilities linked to the context for the three references above

The unit is historically strongly involved in continuing improvement and dissemination of the INRAE feeding systems for the ruminants towards the economic world. The unit is involved with their lecturer-researchers in the creation of a continuing training on the nutrition of domestic ruminants destined to the professionals and contributes to the development of goat farming systems through different structuring actions.

The unit has also developed an invention with secret know-how (miniaturized in vitro fermentation system), what could contribute to maintaining an edge in this domain and could open up opportunities of collaboration with both academic and non-academic partners.

The unit has significant interactions with non-academic structures as evidenced by the number of PhD thesis co-financed by/for the private sector, in particular with seven Cifre theses defended on the evaluating period.

Weaknesses and risks linked to the context for the three references above

While the unit is strongly involved with the economic world and has strong links with the goat sector, few actions have been conducted towards the general public over the evaluating period. Yet, the unit's inclusion in AgroParisTech and a big campus such as Paris-Saclay should provide significant opportunities to develop more actions of communication. This relative weakness may result in a lack of visibility of the unit, especially in its local environment.

Despite the invention involving secret know-how, the unit did not record any patents, licenses, or LabCom during the evaluation period.

ANALYSIS OF THE UNIT'S TRAJECTORY

The MoSAR, for Systemic Modelling Applied to Ruminants, unit exists since 2010. The unit has a long-standing expertise in ruminant nutritional physiology and feed evaluation, mainly applied to dairy goats, as well as in systemic modelling of animal physiology and biology. The scientific objectives of the MoSAR unit have evolved to give to the systemic modelling aspect a more central role in the team project, together with a focus on the characterisation of phenotypic variation in the acquisition and allocation of nutrients to different biological functions. During the evaluation period, the direction team composed of Maryline Boval as director and Philippe Schmidely as deputy director was replaced from January 1, 2023, by a completely new team composed of Laurence Puillet as director and three deputy directors, Christelle Loncke, Rafael Munoz-Tamayo, Masoomeh Taghipoor.

During the evaluation period, the full-time equivalent (FTE) scientific staff decreased by almost one third (15 to 10.5). The activity profile of the unit is mainly distributed among "research and research supervision" (48%), "contribution to innovative teaching based on research" (25%), "research administration" (15%), and "valorisation, transfer and innovation" (10%).

The SWOT analysis achieved by the unit clearly and very honestly highlights the strengths, weaknesses, opportunities and threats of the MoSAR unit. The main strengths on which the unit can build are 1) the modelling expertise widely recognised, 2) the attractiveness for collaboration and 3) the dairy goat herd, although the capacity of the unit to sustain it is questioned in terms of finances and staff.

From a well-conducted analysis of the challenges for sustainable livestock production and related scientific questions in line with the current expertise of the MoSAR unit, a sounded aim has been defined for the coming 5-year period: "*improve understanding and quantification of feed efficiency, resilience and robustness of ruminants to make better use of resources through livestock farming and limit external supplies.*" This objective is broken down into two areas of research: Axis 1: Understand feed efficiency (FE) to better quantify and manage it; Axis 2: Understand the relationships between FE, resilience and robustness to identify levers for action towards sustainable feed efficiency.

By focusing modelling activities almost exclusively on the level of the ruminant animal, MoSAR may miss out on some of the objectives put forward by the parent institutes INRAE and AgroParisTech, specifically towards the transition towards sustainable livestock farming.

For working on the objectives described above with a small unit like MoSAR, understaffing is a risk in some of the activities that can be considered essential. While the understaffing at the goat farm is currently being fixed, the activities in the laboratories, in particular the highly innovative continuous culture in vitro fermentation system is not yet safeguarded for the coming years.

The research project appears broad and ambitious for a total of 6.5 research FTE. In Axis 1, the unit ambitions 1) to investigate digestive efficiency, with the role of the rumen microbiota and metabolic efficiency with the role of liver and body reserves, and 2) to phenotype the numerous components of feed efficiency and their temporal dimension. With only 2.8 FTE researchers on this axis, we encourage the unit to develop a strategy to prioritize the specific questions the unit wants and can investigate. UMR MoSAR has already strong collaborations with other research units in this Axis, and this should help to better identify the complementarities and specificities UMR MoSAR can focus on with the dairy goat model and the modelling approaches.

In Axis 2 the unit ambitions to investigate the relationship between feed efficiency, resilience and robustness. The concept of "sustainable feed efficiency" is original and promising. We encourage the unit also to develop a strategy in this axis to prioritize the research questions they will investigate taking into account collaborations with other research units within INRAE and outside.

The strong emphasis on modelling in connection with phenotyping efforts requires a careful strategy on choosing collaborative partners for doing the experimental work, or doing it /maintaining it within the unit. This may for example also affect the use of the goat facility, which is a high-tech phenotyping unit, but, on the other hand, has little opportunity to generate projects with the major portion of dairy production in France. MoSAR leadership clearly indicates that maintaining the combination of modelling, phenotyping and in vitro work are key to the work conducted. Currently, decisions seem to be made based merely on opportunity rather than strategy. While choices based on opportunity are a part of life in research management, long-term survival would benefit from a bit more strategic choices in the complex landscape of industry and scientific partners in and outside France.

RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

The profile described in the trajectory is a very good strategy to work on future objectives.

Considering the potential and expertise of MoSAR, especially in modelling and phenotyping in goats, the unit can be encouraged to even better develop and highlight the genericity of their models.

The choice of facilities to use (own facilities or through collaboration) to reach the objectives of the unit deserves careful and continuous consideration and an approach that is a little more strategic (rather than opportunity-based).

To effectively work on its ambitions, MoSAR already works on the appointment of new staff members. We underline the importance of this, particularly in the area of its laboratory activities/in vitro fermentation expertise. Adaptative solutions to pool or reduce some administrative and collective tasks may also help the scientists and technical staff to focus on their core missions.

The management led by a director and three deputies has served its purpose well in the complex transition after moving of facilities, and facing the extremely complex process of losses of scientific and technical staff. For governing the research strategy as outlined in the trajectory, a simpler, smaller form of management can be considered (with a delegation of specific tasks) as it can save valuable time in a small research unit like MoSAR.

The MoSAR leadership has demonstrated great awareness of the importance of team building in the unit. However, as four main scientists are involved in this leadership, we recommend considering appointing an independent confidence person (preferably from outside the unit) and make sure everybody (staff, technicians, PhD students) is aware of who to turn to in the case of problems. This can help MoSAR in dealing with conflicting interests/characters within the unit.

Recommendations regarding the Evaluation Area 2: Attractiveness

During the visit we briefly contacted with the PhD students and postdocs. This population has been increasing in size, which is an excellent development. The unit will have to continue an important recruitment of PhD and postdoc fellows to carry out its trajectory. It is important, not only for scientific output, but also for the atmosphere in the group to have an active population of PhD students. It contributes greatly to the attractiveness of the unit. In addition, we encourage:

- to promote the preparation of the HDR among younger scientists;
- to continue with the open science dynamic, which is a key factor in enhancing attractiveness;
- build on and capitalize on existing collaborative networks, in particular with units performing research on dairy cows and considering modelling at higher levels of aggregation (herd, food systems).

Recommendations regarding Evaluation Area 3: Scientific Production

The unit will have to face the loss of high publishing researchers through geographic mobility and retirement. Thus, the unit will have to create the best conditions possible to favour the publications of younger scientists. Improving the number of publications per FTE is linked to the increase of the number of HDR to host more PhD students, to good scientific collaborations. For scientists that may have difficulties to publish, the unit has to analyze the underlying cause. Potentially, encouragement to follow scientific writing training that exists within INRAE or outside (e.g. EAAP) could contribute to improvements here. In addition, to increase the population of PhD students/postdocs, the unit needs to consider the option of attracting a high-profile researcher capable of stimulating the good work of MoSAR. There is a great opportunity of connecting the modelling efforts to objectives formulated by the supervising bodies, potentially leading to spin off activities, as stimulated by INRAE.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

Keep up the good work in bringing the science to society, via science-based products or knowledge to industry, through teaching or other activities. In addition, the unit could think about strategies to increase awareness among MoSAR scientists about the wishes of society. That stretches further than listening to the needs of the industry producing animal-source food.

CONDUCT OF THE INTERVIEWS

Date

Start: 28t November 2024 at 8:30 a.m.

End: 28 November 2024 at 5 p.m.

Interview conducted: on-site

INTERVIEW SCHEDULE

Part 1: General presentations (participation of all members of the unit & representatives of supervising bodies)

8:30 a.m. - 8:45 a.m.	Introduction (Chair of the committee and Hcéres Scientific Advisor)
8:45 a.m. - 9:05 a.m.	Presentation of the team, organization and scientific policy (L. Puillet + CODIR)
9:05 a.m. - 9:25 a.m.	Discussion with the committee
9:25 a.m. - 9:40 a.m.	Interface 1 Feed x Animal (M. Taghipoor)
9:40 a.m. - 9:55 a.m.	Discussion with the committee
9:55 a.m. - 10:10 a.m.	Interface 2 Microbiota x Animal (V. Berthelot, R. Muñoz-Tamayo)
10:10 a.m. - 10:25 a.m.	Discussion with the committee
10:25 a.m. - 10:50 a.m.	Break + committee debriefing (closed)
10:50 a.m. - 11:05 a.m.	Interface 3 Organs x Animal (O. Martin)
11:05 a.m. - 11:20 a.m.	Discussion with the committee
11:20 a.m. - 11:40 a.m.	Trajectory of the unit (L. Puillet + CODIR)
11:40 a.m. - 12 p.m.	Discussion with the committee
12 p.m. - 1:30 p.m.	Lunch break+ committee debriefing (closed)

Part 2: Meetings with lab members (closed meetings)

1:30 p.m. - 2 p.m.	Meeting with teacher-researchers & researchers (without the direction of the unit)
2 p.m. - 2:30 p.m.	Meeting with the technical & administrative staff
2:30 p.m. - 3 p.m.	Meeting with PhD fellows, postdocs and contractual researchers (without supervisors)

Part 3: Meetings with funding bodies' representatives and unit direction (closed meetings)

3 p.m. - 3:30 p.m.	Meeting with the INRAE PHASE (X. Fernandez (CD), F. Gondret (CDA), O. Sandra (CRHD)) and AgroParisTech (A. Péry, dir. DRITT)
3:30 p.m. - 4 p.m.	Meeting with the direction of the unit (L. Puillet + M. Taghipoor, C. Loncke, R. Muñoz-Tamayo)
4 p.m. - 5 p.m.	Final debriefing of the committee (closed)
5 p.m.	Departure

GENERAL OBSERVATIONS OF THE SUPERVISORS

A Palaiseau, le 25 février 2025

Objet : Observations de portée générale sur le rapport DER-PUR260024780 - MoSAR - Modélisation systémique appliquée aux ruminants

Au département d'évaluation de la recherche du HCERES

Comme demandé dans votre message du 11 février 2025, vous trouverez ci-dessous les observations de portée générale sur ce rapport, rédigées en concertation entre les tutelles, en anglais, en cohérence avec la langue du rapport.

INRAE (Phase division) and AgroParisTech would first thank the members of the committee for their impressive and thorough work of analysis and recommendations. They are please to read the very good global assessment of the unit, on all aspects: management, attractiveness, open science, quality of scientific production and contributions to Society. They congratulate the members of the unit and, in particular, the management team of MoSAR, for this.

INRAE and AgroParisTech also note that the committee approve the reorganization into two axes, namely "Understand feed efficiency (FE) to better quantify and manage it" and "Understand the relationships between FE, resilience and robustness to identify levers for actions toward sustainable feed efficiency".

In response to the potential weakness in page 8 relative to an improvement of the connection with the objectives of the supervisory authorities, INRAE and AgroParisTech confirm instead that they expect the activities of MoSAR to be centered at animal level. The unit will thus contribute, together with other units to objectives at higher level (farming systems in particular).

For AgroParisTech
Alexandre PERY
Directeur de la Recherche, de l'Innovation et du Transfert Technologique

For INRAE, Phase Division
Xavier FERNANDEZ
Chef du département

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